Contents

Preface vii
Supporting Organizations and Sponsors viii

Section I. Fuel Fabrication and Performance

Irradiation behavior of metallic fast reactor fuels, *R.G. Pahl, D.L. Porter, D.C. Crawford and L.C. Walters* . 3
MOX fuel development: yesterday, today and tomorrow, *H. Bairiot and P. Deramaix* 10
Development and characteristics of the rim region in high burnup UO_2 fuel pellets, *M.E. Cunningham, M.D. Freshley and D.D. Lanning* 19
Preparation of uranium nitride in the form of microspheres, *G. Ledergerber, Z. Kopajtic, F. Ingold and R.W. Stratton* 28
Mechanism and kinetics of the uranium–plutonium mononitride synthesis, *P. Bardelle and D. Warin* .. 36
Irradiation of a 19 pin subassembly with mixed carbide fuel in KNK II, *D. Geithoff, G. Mühling and K. Richter* 43
Fission product behaviour in Phenix fuel pins at high burnup, *M. Tourasse, M. Boidron and B. Pasquet* .. 49
Fission product behaviour in fast breeder fuel pins, *O. Götzmann* 58
Microstructural change and its influence on fission gas release in high burnup UO_2 fuel, *K. Une, K. Nogita, S. Kashibe and M. Imamura* 65
Concerning the microstructure changes that occur at the surface of UO_2 pellets on irradiation to high burnup, *C.T. Walker, T. Kameyama, S. Kitajima and M. Kinoshita* 73
Microstructural analysis of LWR spent fuels at high burnup, *L.E. Thomas, C.E. Beyer and L.A. Charlot* 80
Transmission electron microscopy study of fission product behaviour in high burnup UO_2, *I.L.F. Ray, H. Thiele and Hj. Matzke* 90
Fuel performance under normal PWR conditions: A review of relevant experimental results and models, *M. Charles and C. Lemaignan* 96
Fuel rod and core materials investigations related to LWR extended burnup operation, *E. Kolstad and C. Vitanza* 104

Section II. Reactor Safety

The Phebus fission product project, *P. von der Hardt and A. Tattegrain* 115
Information on the evolution of severe LWR fuel element damage obtained in the CORA program, *G. Schanz, S. Hagen, P. Hofmann, G. Schumacher and L. Sepold* 131
Fuel behaviour under severe accident conditions: Interpretation of PTE results from the CABRI test programme, *H. Steiner* 146
Failure behavior of plutonium–uranium mixed oxide fuel under reactivity-initiated accident condition, *T. Abe, N. Nakae, K. Kodato, M. Matsumoto and T. Inabe* 154
Transient fuel behavior of preirradiated PWR fuels under reactivity initiated accident conditions, *T. Fujishiro, K. Yanagisawa, K. Ishijima and K. Shiba* . 162
UO_2 fuel behavior under RIA type tests, *G. Negut and M. Popov* 168
On the kinetics of UO_2 interaction with molten Zircaloy at high temperatures, *M.S. Veshchunov and A.M. Volchek* 177

Section III. Basic Properties of Nuclear Materials

Neutron irradiation effects in boron carbides: Evolution of microstructure and thermal properties, *K. Froment, D. Gosset, M. Guéry, B. Kryger and C. Verdeau* 185
On the theory of high temperature transition in fluorite-type oxides, *M.S. Veshchunov* 189
Thermal conductivity of $(U, Pu)O_{2-x}$ mixed oxide fuel, *Y. Philipponneau* 194
Thermal conductivity of SIMFUEL, *P.G. Lucuta, Hj. Matzke, R.A. Verrall and H.A. Tasman* 198
High temperature heat capacities and electrical conductivities of UO_2 doped with yttrium and simulated fission products, *T. Matsui, Y. Arita and K. Naito* 205
Defect structure and oxygen diffusion in $UO_{2+\delta}$, *J.P. Goff, B. Fåk, W. Hayes and M.T. Hutchings* 210
A comparison of the behaviour of fission gases in $UO_{2\pm x}$ and α-U_3O_{8-z}, *R.G.J. Ball and R.W. Grimes* 216
Effect of temperature on bubble precipitation in uranium dioxide implanted with krypton and xenon ions, *J.H. Evans* 222
Investigation of nuclear mixed oxide fuel–gas interaction by a solid electrolyte based coulometric technique, *K. Teske, C. Nebelung, H. Ullman, I.I. Kapshukov, L.V. Sudakov and A.S. Bevz* 226
Nonideality of the solid solution in $(U, Pu)O_2$ nuclear fuels, *M. Beauvy* 232
Vaporization behavior of uranium–plutonium mixed nitride, *Y. Suzuki, A. Maeda, Y. Arai and T. Ohmichi* 239
The fate of nitrogen upon reprocessing of nitride fuels, *N. Hadibi-Olschewski, J.-P. Glatz, H. Bokelund and M.J.-F. Leroy* 244
Stability and structure of the δ phase of the U–Zr alloys, *M. Akabori, A. Itoh, T. Ogawa, F. Kobayashi and Y. Suzuki* 249
Study of the oxidation of a stainless steel under BWR conditions by advanced analytical techniques, *C. Degueldre, J.C. Dran and E. Schenker* 255
Modelling of inert gas bubble behaviour during annealing of irradiated molybdenum, *V.F. Chkuaseli* 258
Mass and gamma spectrometric measurements of fission products released from overheated, fresh irradiated, uranium dioxide, *R.H.J. Tanke* 262

Structural analysis of oxide scales grown on zirconium alloys in autoclaves and in a PWR, *H. Blank, G. Bart and H. Thiele* 273
Carbon activity measurements in boron carbides using a solid state potentiometric cell, *K. Froment, C. Chatillon, J. Fouletier and M. Fouletier* 280
Ion implantation studies of UO_2 and UN, *Hj. Matzke and A. Turos* 285

Section IV. Modelling of Fuel Performance

TRANSURANUS: a fuel rod analysis code ready for use, *K. Lassmann* 295
GERMINAL – A computer code for predicting fuel pin behaviour, *J.C. Melis, L. Roche, J.P. Piron and J. Truffert* 303
Modelling fission gas behaviour in mixed oxide fuel under normal and off-normal conditions in fast reactors, *L. Väth* 308
Mechanistic model of fission gas behavior in metallic fuel, *Y. Tsuboi, T. Ogata, M. Kinoshita and H. Saito* 312
Simplified model for the analysis on the duct wall deflection due to in-reactor creep in LMFBR fuel assemblies, *S. Komoda, N. Nakae and M. Matsumoto* 319
Modelling of $(U, Gd)O_2$ fuel behaviour in boiling water reactors, *A.R. Massih, S. Persson and Z. Weiss* . 323
Development of the thermal behavior analysis code DIRAD and the fuel design procedure for LMFBR, *N. Nakae, K. Tanaka, H. Nakajima and M. Matsumoto* 331

Author index 337

Subject index 341